RELATION OF SOIL AND FERTILIZER NITROGEN TO YIELD AND COMPOSITION OF CORN

BY

CARL GRAY

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SUBMITTED IN PARTIAL FULFILLMENT OF THE REQUIREMENTS
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RELATION OF SOIL AND FERTILIZER NITROGEN TO YIELD AND COMPOSITION OF CORN

I. Introduction

Inorganic nitrogen is the immediate source of nitrogen utilized by plants. Correlation of the inorganic nitrogen in the soil with plant growth is not feasible because of the wide daily and seasonal fluctuations of nitrates, the relation of the amount of nitrates taken up by the crop to the amount present in the soil at any one time, the loss of nitrate nitrogen by leaching, and competition of plants and micro-organisms for inorganic nitrogen.

It was the purpose of this investigation to study the relationships of fertilizer, cropping history, and the organic nitrogen fractions of soils as to their ability to supply nitrogen to the corn plant.

II. Procedure

The field experiments of this study were carried out in various farmers' fields in Champaign County under normal conditions and cultural practices. Applications of ammonium nitrate were made in 180 pound increments up to 540 pounds per acre in order to determine the maximum response due to nitrogen. Total pounds of nitrogen per acre taken up by the corn plant were calculated from the yield and nitrogen composition of the grain and stover.

Soil samples from the untreated plots were analyzed for total soil nitrogen and various soluble nitrogen fractions according to classical procedures. Attempts were made to correlate the laboratory analysis data with the field experiment data in an effort to explain the variations of crop growth which were obtained.

III. Results and Conclusions

The nitrogen uptake by the corn crop was increased on all of the soils studied by the application of ammonium nitrate in increments of 180, 360, and 540 pounds per acre. The largest increases were obtained from the first increments of fertilizer with smaller increases for succeeding increments.

The yields of corn grain grown in 1950 on soils in essentially a corn-beans rotation with no additional nitrogen supplied by other legumes were related to the total nitrogen contents of the surface soil according to the equation $y = 0.0167x - 2.4$. The correlation

coefficient was 0.903 which was significant at the 1 percent level. Thus, 1 bushel of corn was produced for each 204 pounds of soil nitrogen.

The total nitrogen contents of the corn crop in a corn-beans rotation were related to total nitrogen contents of the surface soils by the equation $y = 0.0154x + 7.8$. The correlation coefficient was 0.651 which was significant at the 5 percent level. From this equation, 126 pounds of soil nitrogen are required to supply 1 pound of nitrogen to the above ground portions of the corn plant.

The nitrogen uptake of corn following an alfalfa-green manure crop was increased by nitrogen fertilization. It was stated that the decrease of soil organic matter contents by decomposition may be reduced by returning to the soil crop residues whose nitrogen contents have been increased by nitrogen fertilization.

Approximately 20 percent of the soil nitrogen was highly resistant to drastic treatments with strong acids and bases. Soil nitrogen could not be extracted with the common fat solvents.

The amount of nitrogen in the alkaline extract, and in humic acid and nonhumic acid fractions were relatively constant percentage values of the total nitrogen content of the soil.

The following conclusions were drawn from this study:

1. The yield and nitrogen uptake of corn is related to the total nitrogen content of the surface soils of Flanagan silt loam which have not received extra nitrogen or excessive amounts of carbonaceous residues.

2. The yield increases of corn following green manure crops is the result of a combination of physical and chemical factors in addition to the release of extra nitrogen.

3. Nitrogen fertilization of the corn crop is important in that additional nitrogen is returned to the soil in the crop residues as a source for organic matter buildup and thus helps to maintain the nitrogen balance of the soil.

4. The soil organic nitrogen extracted with alkaline reagents are relatively constant percentage values of the total soil nitrogen. Differences in the nature of the organic matter of Flanagan silt loam whose nitrogen ranges from 2900 to 5800 pounds per acre are very slight.

VITA

The author was born November 5, 1920 at Neodesha, Kansas. He was graduated from the Neodesha High School in 1937 and attended the Independence Junior College, Independence, Kansas, for two years, graduating in 1939. He entered Kansas State College in 1940 and received the Degree of Bachelor of Science with a major in Agronomy in February, 1943. After three years of military service he entered the Graduate School of Kansas State College in February, 1946, and received the Degree of Master of Science in Agronomy in June, 1947. He was employed by the Texas Research Foundation, Renner, Texas, as a Research Assistant in soil research June, 1947, and entered the Graduate School of the University of Illinois September, 1947. He returned to the Texas Research Foundation in February, 1948, where he worked until he resigned to accept a half-time appointment as Special Research Assistant in Soil Fertility in the Department of Agronomy at the University of Illinois September, 1949.

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